

Interactive comment on “Streamflow variability over 1881–2011 period in northern Quebec: comparison of hydrological reconstructions based on tree rings and on geopotential height field reanalysis” by P. Brigode et al.

Anonymous Referee #1

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Brigode et al.: Streamflow variability over 1881-2011 period in northern Quebec: comparison of hydrological reconstructions based on tree rings and on geopotential height field reanalysis

This manuscript provides a description and evaluation of streamflow reconstruction for the Caniapiscau Reservoir in northern Quebec (Canada) using a hydroclimatic reconstruction method that involves geopotential height reanalysis data, air temperature reanalysis data from the Berkeley Earth Surface temperature (BEST) analysis, an analogue approach to develop air temperature and precipitation data for the region, and

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rainfall-runoff modeling with the GR4J model. The interesting approach is of value for presentation and discussion. In regards to the items requested by the journal:

1. Does the paper address relevant scientific questions within the scope of CP? The paper is about a reconstruction of streamflows, so it seems appropriate.
2. Does the paper present novel concepts, ideas, tools, or data? The approach presented does seem novel and, if edited to be more clear and complete, should be a useful presentation of the tools used.
3. Are substantial conclusions reached? The authors reach conclusions that are not always clear but are probably useful and substantial. See additional comments on manuscript.
4. Are the scientific methods and assumptions valid and clearly outlined? Some of the methods are adequately presented, but as someone unfamiliar with the techniques the authors used, I found it difficult to follow the methods at times. In addition, very little information is provided on the rainfall-runoff model so that the use of that model is not adequately justified and validated in the manuscript.
5. Are the results sufficient to support the interpretations and conclusions? The results presented seem necessary to support most of the interpretations and conclusions. As stated above, more information is needed regarding the rainfall-runoff model to support the interpretations and conclusions. I also found it difficult to follow a lot of the arguments in the discussion. I suggest careful rewording to make arguments more clear.
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes, for some of the methods, but not for others. See additional comments on the manuscript.
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes, citations seem appropriate.

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8. Does the title clearly reflect the contents of the paper? Yes, the title seems appropriate.

9. Does the abstract provide a concise and complete summary? Overall the abstract is okay, but somewhat misrepresents the results for precipitation reconstructions and streamflow reconstructions. See additional comments.

10. Is the overall presentation well structured and clear? Not always. See additional comments on manuscript.

11. Is the language fluent and precise? In general, the language is appropriate, although some wording is a bit awkward or unusual. In addition, I had a lot of difficulty following the discussion and suggest the authors reword most of the text there to be more clear about what they are arguing. See additional comments on manuscript.

12. Are the mathematical formulae, symbols, abbreviations, and units correctly defined and used? The formulae provided seem adequately described. However, I would encourage including some equations regarding the rainfall-runoff model. In addition, the description of some of the parameters in Equation (4) do not seem correct (see additional comments on manuscript).

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? In general the organization is appropriate, but there are a few places of repetition, and some clarification of figures or tables might be helpful (see additional comments on manuscript). The colors on the figures are hard to discern, especially for the light grey and grey lines.

14. Are the number and quality of references appropriate? Yes.

15. Is the amount and quality of supplementary material appropriate? I did not review any supplementary material.

Overall, the questions addressed by the modeling effort are interesting and the results presented are also interesting. However, I do not feel enough information has

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been provided to substantiate the findings of the paper due to the lack of detail on the rainfall-runoff modeling. The authors refer to several citations about the model, but the application of the model to this study should be justified. To do this, information on how the model was calibrated needs to be described to show that such calibration was appropriate for the current use. Performance metrics of the calibration should be included. In addition, the model itself needs to be described regarding what inputs are needed, what the “4 and 2 free parameters to calibrate” are (that wording was very confusing to me; line 429). There should also be a description of what those calibrated parameters were and whether their values are appropriate. Their influence on the model results for the study described in this manuscript would also be helpful, given that streamflow reconstruction with the model had discrepancies.

I suggest that the authors need to make clearer the inputs needed for the reconstructed streamflows – I assumed it was time series of air temperatures and precipitation only, but that never clearly stated. The timestep necessary for these inputs also should be clear.

This relates to another thing that was unclear to me regarding why the authors used daily data if all of the comparisons/results shown were monthly. I am guessing the reason is possibly because the rainfall-runoff model only operated at the monthly timestep (relates to the lack of detail on the rainfall-runoff model). Alternatively, perhaps the reservoir operations would like daily data and hence, the approach needs to produce daily data. If this latter is the case, then the authors should present daily results and model performance as well, even if they do not perform as strongly as the monthly summaries of results. Regardless, there needs to be some explanation regarding why daily inputs are needed, but only monthly and annual results are reported.

I also had some difficulty following the terms used by the authors. This may be because I am not an atmospheric scientist and if the journal feels that its audience is most likely to follow the terminology used then these comments may not be valid. In particular, I was not familiar with “geopotential height,” which therefore made discussion of one of

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the primary datasets used for the reconstructions to be very difficult for me to follow. I recommend if the audience for this article is likely to be interdisciplinary, that the authors provide more description of what geopotential height is and how that relates to the data they used in their study. Also, the authors use “reconstitute” or “reconstitution” quite a bit in the manuscript. I think a more appropriate word is “reconstruct” or “reconstruction.” The meaning of “reconstitute” is different from “reconstruct” and I think it is inappropriate here.

Additional comments are as follows (note: line numbers refer to manuscript-version1):

1. Abstract: Suggest rewording line 9 “to compare the obtained streamflow series” to something like “to compare streamflow series obtained with the new method” to be more clear (but also, compare to what?)
2. Line 58: The colon (:) after “Canada” seems inappropriate. I suggest just starting a new sentence with “The length (number of years). . .”
3. Line 59: What is “(cQ)2”? Is this an abbreviation for something? If it is a publically available database, should a website be given?
4. Line 87: Suggest changing “consisting in cal-” to “consisting of cal-”
5. Line 143: Is 15,240 megawatts for the whole complex or just for Caniapiscaw Reservoir?
6. Section 2.1.1: I am unfamiliar with geopotential height reanalysis and a couple of sentences here to define the approach would be useful.
7. Lines 195-196: I did not understand what the “5 first” were that were extracted – what determines what are first and last in the 56 members?
8. Lines 203-204: Keep the greater than sign (>) with the numbers (i.e., >100)
9. Lines 242-244: This is a fragment sentence – please reword

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10. Lines 247-248: What is meant by “A daily catchment series” – do you mean a series of air temperatures for the catchment of Caniapiscaw reservoir?
11. Line 255: Change “is coming” to “comes”
12. Line 258: change “system” to “systems”
13. Lines 258-259: Why is the La Grande system one of the most important hydropower systems in the world?
14. Line 265: Should “abound” be “around”?
15. Line 314: What do pressure fields have to do with analogue days?
16. Line 314: change “fields” to “field”
17. Section 3.1.1: The authors made a good attempt to explain this complicated process of finding analogue days, and Table 1 was helpful. More detail on the Teweles and Wobus (1954) distance is needed – I was not familiar with it, so lines 359-362 were not helpful in describing how the ranking was done (I also suggest avoiding such colloquial phrasing as “thanks to” to be more clear). As I interpreted by reading between the lines, it looks like 20 time series were created for M1, 20 time series were created for M2, and so on. If so, could that also be explicitly stated?
18. Line 404: I think a closing parenthesis is missing for “T(dk)”
19. Line 410: Delete “In conclusion,” – the paper is not finished yet.
20. Lines 414-419: I suggest deleting these two sentences as they are repetitive with statements in Section 3.1.2.
21. Section 3.2: Please see previous comments about needing more detail on the rainfall-runoff model.
22. Lines 439-444: Description of the Kuentz et al. (2013) study belongs more in the discussion where the authors could compare their results with those of the previous

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(similar) study.

23. Line 455: State what is a good value versus a bad value for KGE (i.e., is 1 best?)
24. Lines 458-462: Wouldn't all values of beta be positive, thus what type of values would indicate an overestimation (perhaps values >1)?
25. Lines 463-468: Wouldn't all values of alpha be positive, thus what type of values would indicate an overdispersion?
26. Lines 469-473: It probably would be helpful to indicate what value is a better result (i.e., 1 is a perfect correlation)
27. Line 496: delete "of" before "yearly"
28. Lines 513-522: Isn't the ANA with the line over it representing the average of the five 20CR members? If so, isn't it expected that it would have less variability than the individual reconstructions? I do suggest that a definition of the terms with the lines over them (5 ANA with line over it and 5 ANATEM with line over it) be given in the text and in the figure captions
29. Lines 523-540: I think that the use of the term "time step" is incorrect here unless the modeling was truly done at different time steps (which should be clearly explained if so). Otherwise, "period" or "resolution" would be more appropriate.
30. Line 540: I suggest using "as expected" rather than "logically" or else explain what you are considering as logical.
31. Section 4.1.2: Is the TEM series referred to here the BEST series?
32. Section 4.2: I was not clear about how this section was providing different information than Section 4.3.1. Perhaps those two sections could be combined?
33. Lines 635-644: Is this paragraph and Figure 7 about output from CemaNeige model? If so, please state so.

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34. Lines 635-644: Why is there a focus on May values? Is this an important month or is it the month with the best fits?
35. Section 4.3.2: Are the reconstructions described here using CemaNeige model?
36. Lines 697-703: How did you determine that the 1950-60 period is an "average period" – was there a statistical analysis done to determine this, or are you arbitrarily deciding it is so?
37. Section 5: I would like to see a discussion of the parameters and limitations of the rainfall-runoff model. Were assumptions made with the rainfall-runoff model reasonable for this application?
38. Line 779: change "representing" to "represent"
39. Lines 799-812: I do not follow the text here. What limited performances are being referred to? What did Kuentz et al. (2015) highlight? How does the work have a perspective of finding an additional series? Is that done and described (I don't think so, but I couldn't really tell what was being stated here)? Please elaborate more on how variables like relative humidity, precipitable water content (what is this?), and local pressure measurements would be used. Would they be used in the rainfall-runoff model? Would they be used to reconstruct precipitation or air temperature? Where would these variables come from? Are they something that you can get from geopotential height? When reconstructing into the past, how do you estimate these variables? Or are you intending to just reconstruct back through the observational record rather than for centuries as would be done with paleoreconstructions using tree-ring data?
40. Lines 813-823: Although the sensitivity analyses results are not shown, it would be useful to know what variables or approaches were sensitive. I did not follow the last sentence – was this lack of uncertainty shown in the results, and if so, can the authors point the reader to what they are referring to?
41. Line 825: Should "model" be added after "rainfall-runoff"?

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42. Lines 824-839: I do not follow what this paragraph is arguing. How (and why) would the parameter set change in changing climate? What parameter set are you talking about – the ones for the rainfall-runoff model, or perhaps the ones for Equation (1)? Please reword the entire paragraph to be more clear.

43. Line 859: change “focusing” to “focus”

44. Figures 3, 4, 5, 6, 8, 9: I have a very difficult time making out the 5*20 ANATEM or 5*20 ANA data in these figures. I cannot distinguish 5*ANA from 5*20 ANATEM in Figure 3. I suggest the authors consider using some different colors for these lines or symbols.

45. Figure 7: Suggest moving “(a)” before “mean annual streamflow” and “(b)” before “May monthly”

46. Figure 9: Should the reference to Nicault et al. (2014) in the caption actually be to Boucher et al. (2011)?

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-5, 2016.